

DWARF SPERM WHALE (*Kogia sima*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The dwarf sperm whale (*Kogia sima*) appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989; McAlpine 2002). Sightings of these animals in the western North Atlantic occur in oceanic waters (Mullin and Fulling 2003; NMFS unpublished data), although there are no stranding records for the east Canadian coast (Willis and Baird 1998). Dwarf sperm whales and pygmy sperm whales (*K. breviceps*) are difficult to differentiate at sea (Caldwell and Caldwell 1989, Wursig *et al.* 2000), and sightings of either species are often categorized as *Kogia* sp. Diagnostic morphological characters have been useful in distinguishing the two *Kogia* species (Barros and Duffield 2003), thus enabling researchers to use stranding data in distributional and ecological studies. Specifically, the distance from the snout to the center of the blowhole in proportion to the animal's total length, as well as the height of the dorsal fin in proportion to the animal's total length, can be used to differentiate between the two *Kogia* species when such measurements are obtainable (Barros and Duffield 2003; Handley 1966). Duffield *et al.* (2003) propose using the molecular weights of myoglobin and hemoglobin, as determined by blood or muscle tissues of stranded animals, as a quick and robust way to provide species confirmation.

Using hematological as well as stable-isotope data, Barros *et al.* (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales, and/or dive deeper during feeding bouts. This may result in differential exposure to marine debris, collision with vessels and other anthropogenic activities between the two *Kogia* species.

The western North Atlantic *Kogia* sp. population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

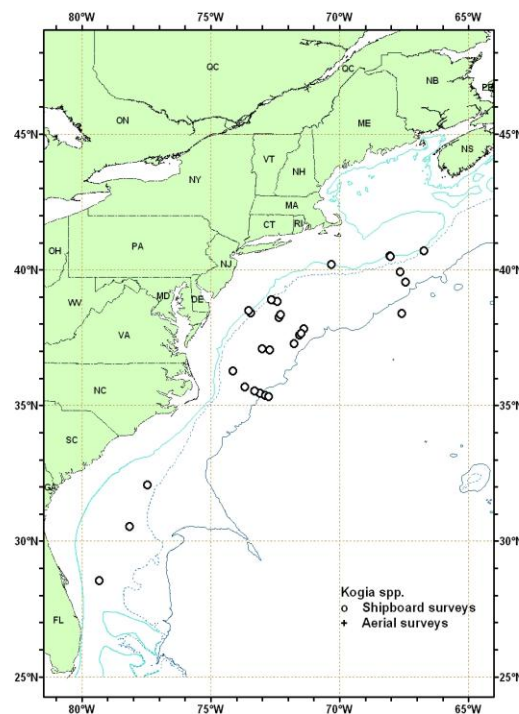


Figure 1. Distribution of *Kogia* sp. sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 2004. Isobaths are at 100 m, 1,000 m and 4,000 m.

POPULATION SIZE

Total numbers of dwarf sperm whales off the U.S. or Canadian Atlantic coast are unknown, although estimates from selected regions of the habitat do exist for select time periods. Because *Kogia sima* and *Kogia breviceps* are difficult to differentiate at sea, the reported abundance estimates are for both species of *Kogia*. The best abundance estimate for *Kogia* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 395 animals (CV=0.40), where the estimate from the northern U.S. Atlantic is 358 (CV=0.44), and from the southern U.S. Atlantic is 37 (CV=0.75). This joint estimate is considered the best because these two surveys together have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance estimate of 695 (CV=0.49) *Kogia* sp. was obtained from the sum of the estimate of 115 (CV=0.61) *Kogia* sp. from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of trackline in waters north of Maryland (38°N) (Palka 2006), and the estimate of 580 (CV=0.57) *Kogia* sp., obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38°N) (Mullin and Fulling 2003).

Recent surveys and abundance estimates

An abundance estimate of 358 (CV= 0.44) for *Kogia* sp. was obtained from a line-transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (about 38° N) to the Bay of Fundy (about 45° N) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and $g(0)$, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for $g(0)$ and biases due to school size and other potential covariates (Palka 2005).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths ≥ 50 m) between 27.5 – 38 °N latitude was conducted during June-August, 2004. The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias $g(0)$ and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for *Kogia* sp. between Florida and Maryland was 37 animals (CV=0.75).

| 1. Summary of abundance estimates for the western North Atlantic <i>Kogia</i> sp. Month, year, and covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation | | | |
|---|------------------------------------|------------|------|
| Month/Year | | N_{best} | CV |
| Jun-Aug 2004 | Maryland to Bay of Fundy | 358 | 0.44 |
| Jun-Aug 2004 | Florida to Maryland | 37 | 0.75 |
| Jun-Aug 2004 | Bay of Fundy to Florida (COMBINED) | 395 | 0.40 |

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log- normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for *Kogia* sp. is 395 (CV=0.40). The minimum population estimate for *Kogia* sp. is 285 animals.

Current Population Trend

The available information is insufficient to evaluate population trends for this species in the western North Atlantic.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a “recovery” factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Kogia* sp. is 285. The maximum productivity rate is 0.04, the default value for cetaceans. The “recovery” factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic *Kogia* sp. is 2.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III. Total annual estimated average fishery-related mortality and serious injury to these stocks during 2001-2005 was zero for *Kogia* sp. , as there were no reports of mortality or serious injury to these species.

Earlier Interactions

No *Kogia* sp. mortalities were observed in 1977-1991 foreign fishing activities.

Pelagic Longline

Between 1992 and 2005, 1 *Kogia* sp. was hooked, released alive and considered seriously injured in 2000 (in the Florida East coast fishing area) (Yeung 2001).

Other Mortality

No dwarf sperm whales were reported to strand in Nova Scotia from 1990-2005 (T. Wimmer, Nova Scotia Marine Animal Response Society, pers. comm.). From 2001-2005, 30 dwarf sperm whales were reported stranded along the U.S. Atlantic coast and 2 were reported stranded in Puerto Rico (Table 2). In addition to the above strandings of *Kogia sima*, there were 11 strandings reported as *Kogia* sp. There were no documented strandings of dwarf sperm whales along the U.S. Atlantic coast during 2001-2005 which were classified as likely caused by fishery or human interactions.

Table 2. Dwarf and pygmy sperm whale (*Kogia sima* (Ks), *Kogia breviceps* (Kb) and *Kogia* sp. (Sp)) strandings along the Atlantic coast, 2001-2005. Strandings which were not reported to species have been reported as *Kogia* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded *Kogia* whales to species, reports to specific species should be viewed with caution.

| STATE | 2001 | | | 2002 | | | 2003 | | | 2004 | | | 2005 | | | TOTALS | | |
|----------------|------|----|----|------|----|----|------|----|----|------|----|----|------|----|----|--------|----|----|
| | Ks | Kb | Sp | Ks | Kb | Sp | Ks | Kb | Sp | Ks | Kb | Sp | Ks | Kb | Sp | Ks | Kb | Sp |
| Massachusetts | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| New York | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| New Jersey | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| Delaware | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maryland | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Virginia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| North Carolina | 1 | 0 | 1 | 0 | 0 | 1 | 4 | 0 | 0 | 2 | 5 | 0 | 4 | 5 | 0 | 11 | 10 | 2 |
| South Carolina | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 8 | 0 | 0 | 8 | 0 | 3 | 16 | 0 |
| Georgia | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 1 | 1 | 10 | 0 | 2 | 3 | 0 | 5 | 13 | 2 |
| Florida | 2 | 0 | 0 | 3 | 0 | 2 | 2 | 0 | 3 | 3 | 8 | 1 | 0 | 3 | 1 | 10 | 11 | 7 |
| Puerto Rico | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| TOTALS | 4 | 0 | 1 | 5 | 0 | 4 | 10 | 0 | 4 | 6 | 31 | 1 | 7 | 20 | 1 | 32 | 51 | 11 |

Historical stranding records (1883-1988) of dwarf sperm whales in the southeastern U.S. (Credle 1988), and strandings recorded during 1988-1997 (Barros *et al.* 1998) indicate that this species accounts for about 17% of all *Kogia* strandings in the entire southeastern U.S. waters. During the period 1990-October 1998, 3 dwarf sperm whale strandings occurred in the northeastern U.S. (Maryland, Massachusetts, and Rhode Island), whereas 43 strandings were documented along the U.S. Atlantic coast between North Carolina and the Florida Keys in the same period. A pair of latex examination gloves was retrieved from the stomach of a dwarf sperm whale stranded in Miami in 1987 (Barros *et al.* 1990). In the period 1987-1994, 1 animal had possible propeller cuts on or near the flukes.

A Mid-Atlantic Offshore Small Cetacean Unusual Mortality Event (UME), was declared when 33 small cetaceans stranded from Maryland to Georgia between July and September 2004. The species involved are generally found offshore and are not expected to strand along the coast. Fifteen pygmy sperm whales (*Kogia breviceps*) and one dwarf sperm whale (*Kogia sima*) were involved in this UME. Two pygmy sperm whales were involved in a multispecies UME in North Carolina in January of 2005 (Hohn *et al.* 2006). Although anthropogenic noise was not definitively implicated, the January 2005 event was associated in time and space with naval sonar activity. Potential risk to this species and others from anthropogenic noise is of concern.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore

necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Rehabilitation challenges for *Kogia* sp. are numerous due to limited knowledge regarding even the basic biology of these species. Advances in recent rehabilitation success has potential implications for future release and tracking of animals at sea to potentially provide information on distribution, movements and habitat use of these species (Manire *et al.* 2004).

STATUS OF STOCK

The status of *Kogia* sp. relative to OSP in the western U.S. Atlantic EEZ is unknown. These species are not listed as endangered or threatened under the Endangered Species Act. There is insufficient information with which to assess population trends. Total U.S. fishery-related mortality and serious injury for these stocks is less than 10% of the calculated PBR and therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. Average annual human-related mortality and serious injury rate does not exceed the PBR, therefore *Kogia* sp. are not strategic stocks.

REFERENCES CITED

- Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6, 73pp. Available from NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037-1508.
- Barros, N.B. and D.A. Duffield. 2003. Unraveling the mysteries of Pygmy and Dwarf sperm whales. Strandings Newsletter of the Southeast U.S. Marine Mammal Stranding Network. December 2003. NOAA Tech. Memo NMFS-SEFSC-521, 11 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, FL 33149.
- Barros, N. B., D. A. Duffield, P. H. Ostrom, D. K. Odell, and V. R. Cornish. 1998. Nearshore vs. offshore ecotype differentiation of *Kogia breviceps* and *K. simus* based on hemoglobin, morphometric and dietary analyses. World Marine Mammal Science Conference Abstracts. Monaco. 20-24 January.
- Barros, N. B., D. K. Odell and G. W. Patton. 1990. Ingestion of plastic debris by stranded marine mammals from Florida. Page 746. In: R.S. Shomura and M.L. Godfrey (eds.) Proceedings of the Second International Conference on Marine Debris. NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-154. Available from NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037-1508.
- Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, New York, 432 pp.
- Caldwell, D. K. and M. C. Caldwell. 1989. Pygmy sperm whale *Kogia breviceps* (de Blainville 1838): dwarf sperm whale *Kogia simus* Owen, 1866. pp. 235-260 In: S.H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, San Diego. 442 pp.
- Credle, V. R. 1988. Magnetite and magnetoreception in dwarf and pygmy sperm whales, *Kogia simus* and *Kogia breviceps*. MSc. Thesis. University of Miami. Coral Gables, FL.
- Duffield, D.A., N.B. Barros, E.O. Espinoza, S. Ploen, F.M.D. Gulland, and J.E. Heyning. 2003. Identifying Pygmy and Dwarf Sperm Whales (Genus *Kogia*) using electrospray ionization mass spectrometry of myoglobin and hemoglobin. Mar. Mammal Sci.19(2):395-399.
- Handley, C.O. 1966. A synopsis of the genus *Kogia* (pygmy sperm whales) in Norris, K.S. (ed) Whales, dolphins, and porpoises. U. of CA Press, xv + 789 pp.
- Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. pp. 179-189. In: G.W. Garner, S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.G. Robertson (eds.) Marine mammal survey and assessment methods. Balkema, Rotterdam. 287 pp.
- Hohn, A.A., D.S. Rotstein, C.A. Harms, and B.L. Southall. 2006. Report on marine mammal unusual mortality event UMESE0501Sp: Multispecies mass stranding of pilot whales (*Globicephala macrorhynchus*), minke whale (*Balaenoptera acutorostrata*), and dwarf sperm whales (*Kogia sima*) in North Carolina on 15-16 January 2005. NOAA Tech. Memo. NMFS-SEFSC-537, 222pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, FL 33149.
- Manire, C.A., H.L. Rhinehart, N.B. Barros, L. Byrd, and P. Cunningham-Smith. 2004. An approach to the rehabilitation of *Kogia* sp. Aquatic Mamm. 30(2):257-270.

- McAlpine, D.F. 2002. Pygmy and Dwarf Sperm whales. pp. 1007-1009. *In*: W.F. Perrin, B. Wursig, and J.G.M. Thewissen (eds.) *Encyclopedia of Marine Mammals*. Academic Press, San Diego, CA.
- Mullin, K. D. and G. L. Fulling. 2003. Abundance and distribution of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. *Fish. Bull., U.S.* 101:603-613.
- Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50 *In*: A. Bjørge and G.P. Donovan (eds.) *Biology of the Phocoenids*. Rep. int. Whal. Commn (Special Issue) 16 I-x + 552 pp.
- Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line-transect estimates of abundance. *Can. J. Fish. Aquat. Sci.* 58: 777-787.
- Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of $g(0)$. *In*: *Proceedings of the workshop on estimation of $g(0)$ in line-transect surveys of cetaceans*, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newsletter No. 44 – Special Issue. April 2005. Pgs. 12-7.
- Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03; 41 p.
(<http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/crd0603.pdf>)
- Wade, P.R., and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.
- Wursig, B., T.A. Jefferson, and D.J. Schmidly. 2000. *The marine mammals of the Gulf of Mexico*. Texas A&M University Press, College Station, TX, 256 pp.
- Willis, P.M., and R.W. Baird. 1998. Status of the dwarf sperm whale (*Kogia simus*) in Canada. *Can. Fld-Nat.* 112:114-125.
- Wursig, B., T.A. Jefferson, and D.J. Schmidly. 2000. *The marine mammals of the Gulf of Mexico*. Texas A&M University Press, College Station, TX, 256 pp.
- Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. NOAA Tech. Memo. NOAA-TM-SEFSC-467, 42 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.